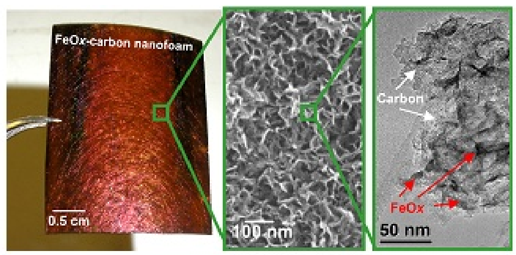
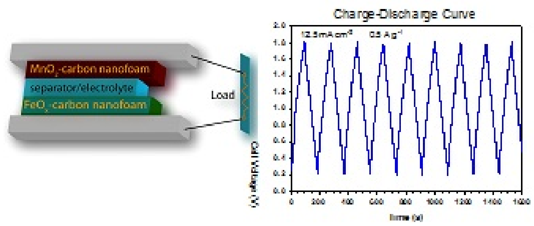
NAVAL RESEARCH LABORATORY

TECHNOLOGY LICENSING OPPORTUNITY

HIGH PERFORMANCE ELECTROCHEMICAL CAPACITORS: NANOSCALE METAL OXIDE COATINGS ON 3D CARBON NANOARCHITECTURES





NRL has developed scalable, solution-based benchtop methods to generate conformal ultrathin (<20-nm thick) metal oxides on the high-surface-area walls of carbon nanofoam papers (0.1-0.3 mm thick). The resulting ultrathin oxides of manganese (Mn) or iron (Fe) rapidly take up and release electrons and ions, thereby storing energy at 300-600 Farads per gram of oxide (with typical oxide loadings of up to 50 wt. %), while the carbon nanofoam paper serves as a 3-dimensional current collector and defines a pre-selected porous electrode architecture. The high surface-to-volume ratio of oxide-painted carbon nanofoam enables footprint-normalized capacitances of 1-10Fcm^{-2} addressable within tens of seconds, a time scale of relevance for hybrid electric vehicles. Pairing MnO*x*-carbon nanofoam with FeO*x*-carbon nanofoam yields an energy-storage device with an extended operating voltage in mild aqueous electrolytes (~2V) that provides technologically relevant energy and power density while also being low cost, safe to operate, and environmentally benign.

References

"Incorporation of Homogeneous, Nanoscale MNO_2 Within Ultraporous Carbon Structures Via Self-Limiting Electroless Deposition: Implications for Electrochemical Capacitors," *Nano Lett.*, 7 (2007) 281-286.

"Electroless Deposition of Conformal Nanoscale Iron Oxide on Carbon Nanoarchitectures for Electrochemical Charge Storage," *ACS Nano*, 4 (2010) 4505-4514.

Available for License: US Patent No. 7,724,500; US Patent Publication No. 2010-0176767; and other patent applications have been filed.

Advantages/Features

Device-ready electrode structures that exhibit up to tenfold increased electrochemical charge storage.

Combination of high-performance electrode materials and aqueous electrolytes results in energy-storage devices that are low cost, safe to operate, environmentally benign, and have relevant energy and power density.

Applications

Hybrid-electric systems

Bridge/back-up power

Energy recovery

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